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Military Affairs

RUSSIAN PRESIDENTIAL MISSILE EXPORT CONTROL DIRECTIVE

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Russian Presidential Missile Export Control Directive

93UM0405A Moscow RASPORYAZHENIYE PREZIDENTA ROSSIYSKOY FEDERATSII in Russian 21 Jan 93 pp 1-59

[Directive of the President of the Russian Federation: "On the Introduction of Control over Exporting from the Russian Federation Equipment, Materials, and Technologies Used in Creating Missile Weapons"]

[Text] Directive of the President of the Russian Federation

On the Introduction of Control over Exporting from the Russian Federation Equipment, Materials, and Technologies Used in Creating Missile Weapons

1. Approve the List of Equipment, Materials, and Technologies Used in Creating Missile Weapons, the Export of Which Is Controlled and Accomplished Under License (attached), submitted by the Government of the Russian Federation.

2. The Government of the Russian Federation shall approve the Statute on the Procedure for Control over Exporting from the Russian Federation Equipment, Materials, and Technologies Used in Creating Missile Weapons.

[Signed] B. Yeltsin, President of the Russian Federation
11 January 1993
No 20-rp

Approved by Directive of the President of the Russian Federation No 20-rp of 11 January 1993

List of Equipment, Materials, and Technologies Used in Creating Missile Weapons from the Russian Federation, the Export of Which Is Controlled and Accomplished Under License

Category I

Table 1

Position Number	Name	Classification Code for Foreign Economic Activity
I.1.	Equipment	
I.1.1.	Completed missile systems (ballistic missiles, missile platforms, and research missiles) capable of delivering a payload of at least 500 kg a distance of 300 km or more	880250000; 930690
I.1.2.	Unmanned atmospheric vehicles (cruise missiles, radio-controlled target drones, and radio-controlled reconnaissance aircraft) capable of delivering a payload of at least 500 kg a distance of 300 km or more	880220-880250; 930690
I.1.3.	Specially designed production capacities for the development and production of missiles and remotely piloted vehicles [RPV's] capable of delivering a payload of at least 500 kg a distance of 300 km or more Definitions: 1. "Development" includes all stages of work, up to and including series "production," such as: —designing; —design research; —analysis of design variants; —working out designing concepts; —assembling and testing prototypes; —pilot production diagrams; —technical documentation; —process of transferring technical documentation to production; —definition of the design make-up; —lay-out diagram; —breadboarding. 2. "Production" includes all stages of production, such as: —developing the production process; —manufacture; —assembly; —production control;	

Table 1 (Continued)

Position Number	Name	Classification Code for Foreign Economic Activity
	—testing; —measures to guarantee quality. 3. "Production capacities" (as applies to this list) include equipment and specially developed software combined within the structure for developing a prototype or accomplishing series production.	
I.1.4.	Individual stages of missiles and RPV's (including booster stages) having the range and payload characteristics indicated in paragraphs I.1.1. and I.1.2.	880390; 930690
I.1.5.	Front sections and warheads of missiles or warheads of RPV's with the equipment stowed in them having the range and payload characteristics indicated in paragaphs I.1.1. and I.1.2.	
I.1.5.1.	front section and warhead fairings and jettisonable shields (shrouds) of missiles and RPV's made of organic matrix-based materials (polyamide, polyimide, polybutylene terephthalate, polycarbonate, and phenol formaldehyde)	880390990
I.1.5.2.	front section (warhead) fairings of missiles and RPV's made of metal matrix-based materials (magnesium and titanium alloys)	880390990
I.1.5.3.	jettisonable front section (warhead) shields (shrouds) of missiles and RPV's made of heat-insulating silicon or quartz fiber-based materials	880390990
I.1.5.4.	jettisonable front section (warhead) shields (shrouds) of missiles and RPV's made of carbon-silicon composite materials efficient at temperatures from 1900 K to 3800 K based on: boron carbide, silicon, titanium, zirconium, and hafnium	880390990
I.1.5.5.	missile warhead cases, including caps and shields (shrouds), including jettisonable ones, made of "carbon-carbon" composite materials	880390990
I.1.5.6.	front section and warhead cases and airframes of missiles and RPV's with heat-protective and multifunctional coatings containing polyisobutylene, fluoroplastics, boron, silicone carbide crystals, and alumina	880390990
I.1.5.7.	front section and warhead cases of missiles and RPV's with heat absorbers made of heat-resistant materials based on graphites (pyrolytic graphites), siliconized graphites, and also graphites alloyed with refractory metals: beryllium, tungsten, niobium, and molybdenum	880390990
I.1.5.8.	heat-insulating and multifunctional shields made of fiber glass fabric made from glass fiber containing up to 50 percent (by weight) in mixture or of any of the following heavy elements: neodymium, praseodymium, lanthanum, cerium, dysprosium, ytterbium	880390990
I.1.5.9.	front section and warhead cases and fairings of missiles and RPV's with radar-absorbing coatings	880390990
I.1.6.	Sets of electronic equipment specially designed or modified for use in front sections (warheads) of missiles and RPV's having the range and payload characteristics indicated in paragraphs I.1.1. and I.1.2.	880390100; 930690
I.1.7.	Missile and RPV guidance systems capable of ensuring a payload delivery accuracy of not more than 3.33 percent of the distance (i.e., a circular error probable [CEP] of 10 km or less at a range of not less than 300 km) Notes: 1. The CEP is an accuracy characteristic and is the radius of a circle whose center coincides with the aiming point and which includes 50 percent of the warhead points of impact. 2. The guidance system is designed to control movement of the missile based on current coordinates and the speed of movement of the missile's center of mass and also the introduction of limits in the control processes, which must be observed during flight in order to ensure delivery of the warhead to the target.	880390100; 930690
I.1.8.	Liquid-propellant rocket engines having a total thrust of 1.1×10^6 N-force (100 tonne-force, 2.5×10^5 pound-force) or more	841210

Table 1 (Continued)

Position Number	Name	Classification Code for Foreign Economic Activity
I.1.9.	Solid-propellant rocket engines having a total thrust of 1.1×10^6N-force (100 tonne-force, 2.5×10^5 pound-force) or more	841210
I.1.10.	Thrust vector control systems including a variable geometry nozzle, injection of liquid or secondary gas into the nozzle, rotation of engine or nozzle, deflection of exhaust gas stream by gas vanes or probes, and use of thrust flaps (trim tabs) for missiles and RPV's having the range and payload characteristics indicated in paragraphs I.1.1. and I.1.2.	841290300
I.1.11.	Mechanisms ensuring safety, arming, and firing of detonator devices of the front section (warhead) of missiles and RPV's having the range and payload characteristics indicated in paragraphs I.1.1. and I.1.2.	880390100; 930690

Table 2

Position Number	Name
I.2.	Technologies Definition: "Technology" (as it applies to this list) is special information which is required to develop, produce, and use a product. This information may be in the form of "technical data" or "technical assistance."
I.2.1.	Design and production technology of individual missile stages and RPV's (including booster stages) having the range and payload characteristics indicated in paragraphs I.1.1. and I.1.2.
I.2.2.	Design and production technology of missile front sections and warheads and RPV warheads with the equipment stowed in them and having the range and payload characteristics indicated in paragraphs I.1.1. and I.1.2.
I.2.3.	Design and production technology of electronic equipment under paragraph I.1.6. that is specially designed or modified for use in the front sections or warheads of missiles and RPV's.
I.2.4.	Design and production technology of missile and RPV systems under paragraph I.1.7. capable of ensuring a payload delivery accuracy of not more than 3.33 percent of the distance
I.2.5.	Design and production technology of liquid-propellant rocket engines having a total thrust of 1.1×10^6N-force (100 tonne-force, 2.5×10^5 pound-force) or more
I.2.6.	Design and production technology of solid-propellant rocket engines having a total thrust of 1.1×10^6N-force (100 tonne-force, 2.5×10^5 pound-force) or more
I.2.7.	Design and production technology of thrust vector control systems, including a variable geometry nozzle, injection of liquid or secondary gas into the nozzle, rotation of engine or nozzle, deflection of the exhaust gas stream by gas vanes or probes, and use of thrust flaps (trim tabs) for missiles and RPV's having the range and payload characteristics indicated in paragraphs I.1.1. and I.1.2.
I.2.8.	Design and production technology of mechanisms ensuring safety, arming, and firing of detonator devices of the front section (warhead) of missiles and RPV's having the range and payload characteristics indicated in paragraphs I.1.1. and I.1.2.
I.2.9.	Design and production technology of front section and warhead fairings and jettisonable shields (shrouds) of missiles and RPV's made of organic matrix-based materials (polyamide, polyimide, polybutylene terephthalate, polycarbonate, and phenol formaldehyde)
I.2.10.	Design and production technology of front section (warhead) fairings of missiles and RPV's made of metal matrix-based materials (magnesium and titanium alloys)
I.2.11.	Design and production technology of jettisonable front section (warhead) shields (shrouds) of missiles and RPV's made of heat-insulating silicon or quartz fiber-based materials
I.2.12.	Design and production technology of jettisonable front section (warhead) shields (shrouds) of missiles and RPV's made of carbon-silicon composite materials efficient at temperatures from 1900 K to 3800 K based on boron carbide, silicon, titanium, zirconium, and hafnium
I.2.13.	Design and production technology of missile warhead cases, including caps and shields (shrouds), including jettisonable ones, made of "carbon-carbon" composite materials
I.2.14.	Design and production technology of front section and warhead cases and airframes of missiles and RPV's with heat-protective and multifunctional coatings containing polyisobutylene, fluoroplastics, boron, silicone carbide crystals, and alumina
I.2.15.	Design and production technology of front section and warhead cases of missiles and RPV's with heat absorbers made of light heat-resistant materials based on graphites (pyrolytic graphites), siliconized graphites, and also graphites alloyed with refractory metals: beryllium, tungsten, niobium, and molybdenum
I.2.16.	Design and production technology of heat-insulating and multifunctional shields made of fiber glass fabric made from glass fiber containing up to 50 percent (by weight) in mixture or of any of the following heavy elements: neodymium, praseodymium, lanthanum, cerium, dysprosium, ytterbium

Table 2 (Continued)

Position Number	Name
I.2.17.	Design and production technology of front section and warhead cases and fairings of missiles and RPV's with radar-absorbing coatings

Category II

Table 3

Position Number	Name	Classification Code for Foreign Economic Activity
II.1.	Materials	
II.1.1.	Types of fuel and their components used in missiles and remotely piloted vehicles [RPV's]	
II.1.1.1.	Hydrazine, having a concentration of over 70 percent, and its derivatives, including monomethyl hydrazine	282510000
II.1.1.2.	Unsymmetrical dimethyl hydrazine	292800000
II.1.1.3.	Liquid oxidizers:	
II.1.1.3.1.	nitrous anhydride;	281129300
II.1.1.3.2.	nitric tetroxide;	281129300
II.1.1.3.3.	nitric anhydride;	281129300
II.1.1.3.4.	inhibited red fuming nitric acid;	280800000
II.1.1.3.5.	compounds containing fluorine and one or more atoms of other halogens, oxygen, or nitrogen	2812; 2826
II.1.1.4.	Ammonium perchlorate with spherical particles less than 500 micrometers in diameter	282990100
II.1.1.5.	Perchlorates, chlorates, and chromates in a mixture with a metallic powder or other high-energy fuel components	282990900; 282919000; 284150000
II.1.1.6.	Aluminum powder with a purity of 97 percent or more with spherical particles less than 500 micrometers in diameter	760310000
II.1.1.7.	Metallic fuel additives in the form of particles less than 500 micrometers in size having a spherical, spheroidal, lamellar, or granular shape and containing 97 percent or more of any of the following components:	
II.1.1.7.1.	zirconium and its alloys;	810910100
II.1.1.7.2.	beryllium and its alloys;	811211000
II.1.1.7.3.	magnesium and its alloys;	810430000
II.1.1.7.4.	boron and its alloys;	280450100
II.1.1.7.5.	zinc and its alloys;	790390000
II.1.1.7.6.	mish metal	280530100
II.1.1.8.	Nitramines:	
II.1.1.8.1.	octogen;	360200000; 293369900
II.1.1.8.2.	hexogen	360200000; 293369100
II.1.1.9.	Polybutadiene with carboxyl end groups	400220000
II.1.1.10.	Polybutadiene with hydroxyl end groups	400220000
II.1.1.11.	Glycidyl azide	400220000
II.1.1.12.	Polybutadiene-acrylic acid	400220000
II.1.1.13.	Polybutadiene-nitrile-acrylic acid	400259000
II.1.1.14.	Catalytic and inhibiting additives to solid fuels:	
II.1.1.14.1.	triphenyl bismuth;	290711000
II.1.1.14.2.	isophorone diisocyanate	292910000
II.1.1.15.	Modifying components regulating speed of combustion of composite solid fuels:	

Table 3 (Continued)

Position Number	Name	Classification Code for Foreign Economic Activity
II.1.1.15.1.	ferrocene;	293100000
II.1.1.15.2.	N-butyl-ferrocene (butacine);	293090800
II.1.1.15.3.	diethylferrocene (DAF) (katocine);	293090800
II.1.1.15.4.	octoxylylferrocene;	294110000
II.1.1.15.5.	lithium fluoride	282619000
II.1.1.16.	Nitroesters and nitroplasticizers:	
II.1.1.16.1.	trinitropropanetriole (NGTs);	290550900
II.1.1.16.2.	trimethylolthantrinitrate;	290550900
II.1.1.16.3.	diethyleneglycol dinitrate;	290550900
II.1.1.16.4.	1,2,4-butanetrioltrinitrate;	290550900
II.1.1.16.5.	triethyleneglycol dinitrate	290550900
II.1.1.17.	Solid fuel stabilizers:	
II.1.1.17.1.	2-nitrodiphenylamine;	292144000
II.1.1.17.2.	N-methyl-para-nitroaniline	292142100
II.1.1.18.	Carboranes, decarboranes, pentaboranes, and their derivatives	290219900; 290359000; 290420900; 290490900
II.1.1.19.	Binding fuel additives:	
II.1.1.19.1.	tris (1-(2-methyl)aziridinyl) phosphorous oxide;	293390900
II.1.1.19.2.	trimesol (1-(2-methyl)aziridine);	293390900
II.1.1.19.3.	"tepanol," a product of the reaction of tetraethylene pentamine, acrylonitrile, and glycidol;	382390980
II.1.1.19.4.	"tepan," a product of the reaction of tetlenpentamine and acrylonitrile;	382390980
II.1.1.19.5.	multifunctional aziridine-amides of isophthalic, trimesic, isocyanuric, or trimethyladininic acid with the presence of dimethyl or diethyl aziridine groups	382390980
II.1.1.20.	High-energy fuels such as boron-containing suspensions with a specific calorific value of 9500 kcal/kg (40 x 10^6 J/kg) and higher	282510000
II.1.2.	Structural materials used in creating the missiles and RPV's	
II.1.2.1.	High-alloyed steels with an increased content of nickel, a low level of carbon, and use of additional input components for hardening, and having an effective strength of 150 kg/sq mm and more at a temperature of -20 degrees C	7219; 7220; 730441900; 730449100
	Note:	
	High-alloyed steels are used in the form of sheets, plates, or pipes with a wall thickness of 5 mm or less	
II.1.2.2.	Tungsten and its alloys in the form of same-size spherical particles or particles produced by spraying with a diameter of 500 micrometers or less with a purity of 97 percent or higher	810110000
II.1.2.3.	Molybdenum and its alloys in the form of same-size spherical particles or particles produced by spraying with a diameter of 500 micrometers or less with a purity of 97 percent or higher	810210000
II.1.2.4.	Composite materials based on polymer, carbon, ceramic, and metal matrices, and also fillers in the form of reinforcing fibers and structures: fiber glass, carbon, boron, silicon carbide, synthetic, and metal, intended for use in missile systems and RPV's and having a specific breaking strength of more than 7.62 x 10^4 meters and a modulus of elasticity of more than 3.18 x 10^6 meters:	
II.1.2.4.1.	made based on polyamide, polyimide, polybutylene terephthalate, polycarbonate, and phenol-formaldehyde matrices;	392690100
II.1.2.4.2.	made based on magnesium matrices;	392690100
II.1.2.4.3.	made based on titanium matrices;	392690100
II.1.2.4.4.	on a fibrous base of quartz fibers (frames);	392690100; 681599100

Table 3 (Continued)

Position Number	Name	Classification Code for Foreign Economic Activity
II.1.2.4.5.	on a carbon-fiber base (frames)	392690100; 3801
II.1.2.4.6.	on a boron-fiber base (frames);	392690100; 280450100
II.1.2.4.7.	on an alumina fibrous base;	392690100; 281820000
II.1.2.4.8.	on a silicon-carbide fibrous base;	284920000; 690310000
II.1.2.4.9.	on a tungsten-wire fibrous base;	810192000
II.1.2.4.10.	on a molybdenum-wire fibrous base;	810292000
II.1.2.4.11.	on a titanium-wire fibrous base;	810890300-810890700
II.1.2.5.	Composite materials for making solid-fuel rocket engine cases, nozzle units, and their components as items of a complex geometric shape (cylinders, spheres, ovals, ellipses, cones, tores) from:	
II.1.2.5.1.	carbon plastics with a density of 1.4 grams/cubic cm and higher;	3801;392690100
II.1.2.5.2.	glass-reinforced plastics with a density of 2.5 grams/cubic cm and higher;	701910;701920
II.1.2.5.3.	organic plastics with a density of 1.3 grams/cubic cm and higher	392690100
II.1.2.6.	Internal inserts based on a composite of fire-resistant and insulating materials of polybutadiene with end hydroxyl groups with carbon, designed to fill the boundaries between the charge and the engine case or for insulation	3801; 690310000; 400220000
II.1.2.6.1.	Solid-propellant rocket engine insulation based on rubber compounds	400510; 400599
	Notes: 1. Internal inserts are designed to fill the boundaries between solid-propellant rocket engine components (its case and insulation), which is accomplished by spraying or smoothing the internal surface of the case 2. Insulation is used as a component of the engine, i.e., its case, the inlet section of the nozzle, diaphragms, including vulcanized or semi-vulcanized rubber support elements containing heat-insulating or fireproof materials. It can be integrated into the shoes or covers to relieve tension.	
II.1.2.7.	"Carbon-carbon" type pyrolytic carbon materials developed specially for missile systems:	
II.1.2.7.1.	carbon-carbon materials with a spatial reinforcement structure (more than two directions of reinforcement) with a density of 1.75 grams/cubic cm or more;	3801
II.1.2.7.2.	carbon-carbon materials produced by the method of winding and lining for thin-walled structural elements with a density of 1.5 grams/cubic cm or more;	3801
II.1.2.8.	Finely dispersed graphite recrystallized in a large volume (with a volume density of at least 1.72 grams/cubic cm, measured at a temperature of +15 degrees C)	3801
II.1.2.9.	Structural high-temperature and erosion-resistant ceramics based on silicon nitride and carbide and efficient at a temperature of 2000 K or higher	284920000; 285000300
II.1.2.10.	Radar-transparent materials based on boron nitride with a dielectric permittivity of 2.8 to 6 at frequencies of 100 Hz to 10 GHz and an operating temperature of 2000 K and higher	280450100; 285000300
II.1.2.11.	Large structural elements (with a diameter of 0.5 meters and higher) with a carbon-reinforced frame and a silicone-carbide matrix (C-SiC-composites) with a density of 1.4-2.1 grams/cubic cm and an exposure operating temperature of up to +1500 degrees C for two hours or more	880390990; 930690
II.1.2.12.	TGN-2M type carbon fabric with a density of 0.55 grams/cubic cm and a heat capacity of 0.67 kJ/kg-C	380120900
II.1.3.	Materials for decreasing observability and reflected illumination energy	

Table 3 (Continued)

Position Number	Name	Classification Code for Foreign Economic Activity
II.1.3.1.	Gradient and (or) interference type high-temperature radar-absorbing materials, including on the basis of organosilicon binding and special fillers (metal powders, carbon black, ferrites, carbonyl iron) retaining magnetic and dielectric properties at a temperature of +350 degrees C or higher and having a wave reflection factor of 10 to 30 percent	391000
II.1.3.2.	Heat- and erosion-resistant radar-transparent materials and coatings, including those based on MSP-K type mineral fiber glass-reinforced plastics, ensuring radar-transparent fairings (inserts) being made have a resistance to a heat flow of up to 1 x 10^{5} kcal/sq m per second at an exposure time of up to 1 second, combined with an excess pressure pulse of over 0.5 kg/sq cm	7019
II.1.3.3.	Fiber glass fabric and glass fiber containing up to 50 percent (by weight) in a mixture of any of the following heavy elements: neodymium, praseodymium, lanthanum, cerium, dysprosium, ytterbium	7019
II.1.3.4.	Coatings, including paints based on organosilicon binders, specially developed to decrease or sharply limit reflection or emission in the microwave (0.1-10 mm) and also the infrared (0.7-100 mcm) and ultraviolet (from 10^{-2} to 0.35 mcm) bands of the spectrum	391000; 381519
II.2.	Equipment	
II.2.1.	Engines, their components, and assemblies used in missiles and RPV's, as well as equipment intended specially for their production	
II.2.1.1.	Light turbojet and turbofan engines, including variable-cycle engines, which have high efficiency and small dimensions, with the following parameter values for N=0 under standard atmospheric conditions: takeoff thrust from 500 to 2000 kgf; specific cruise fuel consumption of not more than 0.8 kg/kgf-hr; specific mass of 0.3 kg/kgf of thrust	841111900
	Notes: 1. Variable-cycle engines are a mechanical combination of various types of engines operating in one flight envelope as an air-breathing jet engine and in another as a rocket engine. An example of a variable-cycle engine is the solid-propellant rocket engine whose combustion chamber is used as a ramjet engine combustion chamber after burn-up of the solid fuel. 2. Engines may be exported as part of a piloted vehicles or in numbers necessary to replace engines in manned aircraft.	
II.2.1.2.	Ramjet supersonic engines, pulsejet engines, and combined-cycle engines, including devices regulating combustion speed, with the following parameter values for N=0 under standard atmospheric conditions: takeoff thrust from 500 to 2000 kgf; specific cruise fuel consumption of not more than 0.8 kg/kgf-hr; specific mass of 0.3 kg/kgf of thrust	841210900
	Note: Examples of combined-cycle engines may be ramjet, bypass turbojet, turborocket, and turboprop rocket engines.	
II.2.1.3.	Special vacuum furnaces with a system for maintaining desired heat conditions for manufacturing turbine blades by the method of oriented crystallization	841780900
II.2.1.4.	Numerical control units for controlling heat conditions and movement of ingot molds in special vacuum furnaces for manufacturing turbine blades	853710100; 853710990
II.2.1.5.	Solid-propellant rocket engine cases	930690
II.2.1.6.	Servo-actuated valves of liquid and gel-like fuel components, designed for consumption of 24 liters/minute or more at an absolute pressure of 70 atmospheres or more with an actuator reaction speed not worse than 100 mks, designed to operate in conditions of vibration acceleration exceeding 10 g-loads (root-mean-square value) in the frequency band from 20 to 2000 Hz	848110900
II.2.1.7.	Cryogenic liquid pumps with a shaft rotational speed of 8000 rpm or more or with an outlet pressure of at least 70 atmospheres and designed to operate under vibration acceleration exceeding 10 g-loads (root-mean-square value) in the frequency band from 20 to 2000 Hz	841319

Table 3 (Continued)

Position Number	Name	Classification Code for Foreign Economic Activity
	Note: Systems and components that apply to paragraphs II.2.1.6. and II.2.1.7. may be exported as satellite components.	
II.2.1.8.	Hybrid rocket engines and their specially designed components	841290300
	Definition	
	A hybrid rocket engine is an engine operating on fuel that has one component that in a solid state and another of which is in a liquid state.	
II.2.1.9.	Rolling mills with numerical control or equipped with a computer with simultaneous control on two or more axes	846390100; 846390900
	Note: Machine tools based on using combined principles of rolling are considered rolling mills.	
II.2.1.9.1.	numerical control units for rolling mills and bending machines with two or more interpolation coordinate axes over which control can be accomplished simultaneously when moving over the contour	853710100; 853710990
II.2.1.9.2.	movement control units specially developed for rolling mills and bending machines having more than two interpolation axes	853710100; 853701990
II.2.1.10.	Charges of composite solid rocket fuels:	
II.2.1.10.1.	charges rigidly bonded to the rocket engine case;	930690100
II.2.1.10.2.	charges inserted in the rocket engine case	930690100
II.2.1.10.3.	inserted charges	360200000
II.2.2.	Equipment for producing, servicing, and acceptance testing of solid and liquid fuels or their components	
II.2.2.1.	Batch and continuous mixers with systems ensuring mixing in a vacuum in the pressure range from 0 to 0.13 atmospheres and with the ability to control the temperature in the mixing chamber:	
II.2.2.1.1.	batch mixers with a total capacity of 110 liters (30 gallons) or more;	847982000
II.2.2.1.2.	portable bulk batch mixers with a total capacity of 1000 liters or more;	847982000
II.2.2.1.3.	batch mixers with at least one off-center mixing drive;	847982000
II.2.2.1.4.	continuous mixers with two or more shafts with an output of 500 kg/hr or more;	847982000
II.2.2.1.5.	continuous mixers with possibility of access into the mixing chamber;	847982000
II.2.2.1.6.	mixers with a capacity of over 3 cubic meters and with planetary agitators for preparing viscous fluid mixtures	847982000
II.2.2.2.	Plasmotrons (high-frequency electric arc) for producing a sprayed or spherical metallic powder with organization of the process in an argon-hydrogen atmosphere	845690000
II.2.2.3.	Electric blasters for producing sprayed or spherical metallic powder with organization of the process in an argon-hydrogen atmosphere	845640000
II.2.2.4.	Plants for producing spherical aluminum powders with a fineness of up to 500 micrometers by spraying the melt in an inert atmosphere (nitrogen)	842420100
II.2.2.5.	Bead mills for pulverizing ammonium perchlorate, octogen, and hexogen in an inert liquid medium (freon)	847982000
II.2.2.6.	Gamma-ray flaw detectors for monitoring the density and quality of uniformity of solid-fuel charges	902219000
II.2.2.7.	Continuous chemical reactor (autoclaves, columns for catalytic high-temperature decomposition, oxidation or reduction, hydration, or increasing the concentration by distillation) for producing hydrazine, asymmetric dimethyl hydrazine, pentaborane, nitrous anhydride, nitric tetroxide, nitric anhydride, inhibited red nitric acid, compounds containing liquid fluorine and one or more atoms of other halogens, oxygen, or nitrogen, and also high-energy fuels, including boron-containing fuels, with a specific calorific value of 9500 kcal/kg (40 x 10^6 J/kg) or higher	847989800

Table 3 (Continued)

Position Number	Name	Classification Code for Foreign Economic Activity
II.2.2.8.	Stationary cylindrical or spherical reservoirs made entirely of or plated with high-alloy steel with an increased nickel content and a low carbon content or with aluminum and with a capacity of over 3 cubic meters, supplied with locking hardware, a thermostatic control system, trays, and special devices for neutralizing vapors of chemically highly active or toxic liquid components of rocket fuels	730900300; 761100000
II.2.2.9.	Transportable cylindrical tanks made entirely of or plated with high-alloy steel with an increased nickel content and a low carbon level or with aluminum and with a capacity of over 2 cubic meters, supplied with locking hardware, a thermostatic control system, and special devices for neutralizing the vapors of chemically highly active or toxic liquid components of rocket fuels	860900900; 871631000
II.2.2.10.	Stationary and movable pressurized or pump-type filling systems, equipped with a metering system and fine filters (20 micrometers), designed to operate with chemically highly active and toxic liquid or gaseous substances and having an output of at least 2 cubic meters/minute	871631000; 870590900; 847989900
II.2.2.11.	Automobile-chassis-mounted systems for collecting, neutralizing, and burning liquid and gaseous chemically highly active and toxic components of rocket fuel; output of at least 2 cubic meters/minute	870590900
II.2.3.	Equipment for producing composite structures specially developed for making solid-propellant rocket engine cases and structural members of missiles and RPV's.	
II.2.3.1.	filament-winding machines whose control of the movement, turning, and winding of the filaments is programmable and accomplished over three or more axes and which have been specially developed for producing composite structures or laminated plastics from fibers or fibrous materials	844630000
II.2.3.2.	Numerical control units for filament-winding machines whose control of the movement, turning, and winding of the fibers is accomplished over three or more axes	853710100; 853710990
II.2.3.3.	Strip-winding machines whose control of the movement and winding of the strip and layers is coordinated and controllable over two or more axes	844630000
II.2.3.4.	Numerical control units for strip-winding machines whose control of the movement and winding of the strip and layers is accomplished over two or more axes	853710100; 853710990
II.2.3.5.	Machines for making interfacial layers, including adapters and modifiers for weaving, alternating, or braiding fibers in order to make composite structures	844621000
II.2.3.6.	Automatic presses and casting plants providing temperature conditions of +200 degrees C and higher	847759100
II.2.3.7.	High-temperature furnaces for roasting fireproof ceramics with operating temperatures of +1400 to +2000 degrees C and residual pressure of 10^{-3} to 10^{-5} atmospheres	841780900
II.2.3.8.	Mixers for pre-mixing of components, with a rating of 2 to 7.5 kW and a capacity of 95 to 113 liters	847982000
II.2.3.9.	Mixers for final mixing of components, with a rating of 14.9 to 37.3 kW and an operating capacity of 75.7 to 378.5 liters	847982000
II.2.3.10.	Machines for producing sheet molded materials, with an output capacity of 341 to 1818 kg/hr	847759400
II.2.3.11.	Casting presses with a force over 200 tonne-force	847759100
II.2.3.12.	Machines for impregnating fiber, with a tension in the roving of 17.8 to 28.7 N	845180900
II.2.3.13.	Machine tools for winding (shaping) a flat strip from the roving, with a speed of 15.2 to 30.5 meters/minute for carbon and aramide fibers and 91.4 to 106.7 meters/minute for the rest of the fibers	844629000

Table 3 (Continued)

Position Number	Name	Classification Code for Foreign Economic Activity
II.2.3.14.	Numerical control units designed for programmed control of the modes of fiber modification or roasting fireproof ceramics, including measuring by time the quality and quantity of processing agents and also regulating the temperature, pressure, and composition of the atmosphere within the chamber	853710000; 853710990
II.2.3.15.	Specially developed atomizers for pyrolytic application of coatings by feeding gaseous products which decompose at temperatures of +1300 to +2900 degrees C and pressures of 1 to 150 mm of mercury	842420100
II.2.3.16.	Numerical control units designed to control the process of sealing and pyrolysis of rocket engine nozzles and end-pieces of warheads made of composite materials	853710100; 853710900
II.2.3.17.	Isostatic presses with an internal diameter of the chamber working surface of 254 mm (10 inches) or more, developing a maximum operating pressure of 700 atmospheres or more, and capable of reaching and maintaining a controllable temperature level of +600 degrees C and higher	846299
II.2.3.18.	Furnaces for precipitation of vapors of chemical elements, designed or modified to compress composite carbon-carbon materials	841780900
	Note: When examining the possibility of export for objects corresponding to positions II.2.3.1.-II.2.3.18., one should bear in mind that as a complete set they may include mandrels, press molds, roller conveyers, attachments for removing or applying coatings, slicing, or cutting, hardware and tools for extrusion, heat treatment, casting, hardening, or splicing the films, composite structures, and materials made from them.	
II.2.4.	Staging mechanisms	
II.2.4.1.	Explosive bolts with electric fuses	731815900
II.2.4.2.	Detonating linear charges (primer cord)	360300100
II.2.4.3.	Solid-propellant rocket micro-motors with a thrust of up to 10 kg and specific pulse of not more than 200 kgf	841210900
II.2.5.	Equipment integrated into flight control systems, specially designed or modified for missiles or RPV's	
II.2.5.1.	Onboard flight control system equipment, including gyrostabilizers or autopilots ensuring a direction of drift of less than 0.5 angular degrees per hour (1 sigma)	901420900
	Note: Onboard flight control equipment in general, other than the gyrostabilizer (autopilot), includes the onboard digital computer system, the amplifier-transfer switching equipment, the power generating system, the onboard cable system, external measuring equipment (star trackers, radar correction equipment, radio altimeters, radar position indicators)	
II.2.5.2.	Inertial or other flight control systems using the acclerometers indicated in paragraphs II.2.5.5 and II.2.5.6 or the gyroscopes indicated in paragraphs II.2.5.7 and II.2.5.8.	901420900
II.2.5.3.	Gyroscopic astrocompasses for determining the current location of an aircraft (missile) by automatic tracking of the heavenly bodies, providing the accuracy of payload delivery indicated in paragraph I.1.7.	901480000
	Note: Gyroscopic astrocompasses include the gyrostabilized platform with the astrosensors, telescopes, and computers located on it.	
II.2.5.4.	Onboard satellite navigation equipment for determining current location by automatic satellite tracking, providing the payload delivery accuracy indicated in paragraph I.1.7.	
	Note: The satellite navigation equipment includes a decimeter-band receiver, antenna-feeder device, computer, power supply, and switching-transfer equipment.	
II.2.5.5.	Various types of accelerometers having a sensitivity of .05 g-loads and less or a linear of 0.25 percent on the full scale	903289
II.2.5.6.	Accelerometers of any type for measuring linear accleration and capable of functioning at accelerations above 100 g-loads	903289

Table 3 (Continued)

Position Number	Name	Classification Code for Foreign Economic Activity
II.2.5.7.	Gyroscopes of any type, capable of functioning at accelerations above 100 g-loads	903289
II.2.5.8.	All types of gyroscopes used in control systems with precession (drift) less than 0.5 angular degrees per hour (1 sigma) at normal thrust	903289
	Notes:	
	1. Precession (drift) is defined as it applies to the difference between real and required deviation. It includes stochastic and systematic components and is expressed as the equivalent angular displacement in a unit of time relative to the inertial space.	
	2. Stability is defined as the standard deviation (1 sigma) of the variation of a specific parameter from its calibrated value, measured under constant temperature conditions. Stability may be expressed as a function of time.	
II.2.5.9.	Specially developed production and monitoring equipment for annular laser gyroscopes and monitoring the characteristics of mirrors, having the accuracy limit indicated in the parentheses or higher:	
II.2.5.9.1.	straight-line dispersion meter (10 parts per million);	903180
II.2.5.9.2.	reflectometer (50 parts per million);	903180
II.2.5.9.3.	profilometer (5 angstroms)	903180
II.2.5.10.	Specially developed production and monitoring equipment for navigation and flight control equipment and systems, including all types of gyroscopes and accelerometers:	
II.2.5.10.1.	checkout equipment for testing the functioning of the inertial measuring unit;	903180
II.2.5.10.2.	checkout equipment for testing the functioning of the gyrostabilized platform;	903180
II.2.5.10.3.	stand for servicing the stabilizing element of the inertial measuring unit;	903120000
II.2.5.10.4.	stand for balancing the gyrostabilized platform of the inertial measuring unit;	903110000
II.2.5.10.5.	unit for testing and aligning the gyroscope;	903120000
II.2.5.10.6.	unit for dynamic balancing of gyroscope;	903110000
II.2.5.10.7.	unit for testing gyroscope motor;	903180
II.2.5.10.8.	unit for adding and pumping out the working medium of the gyroscope;	841381900
II.2.5.10.9.	centrifuge stand for checking gyroscope mounts;	903120000
II.2.5.10.10.	station for axial adjustment of accelerometer;	903120000
II.2.5.10.11.	unit for testing accelerometer	903120000
II.2.5.11.	Flight stabilization system hydraulic drives, including amplifier (electronic), hydraulic control valve, and hydraulic servo motor	903281900
II.2.5.12.	Flight stabilization systems mechanical drives, including spring-and-lever and geared elements of transferring movement of an aircraft in space to its servo elements (control surfaces, rotating nozzle, and so forth), registered by measuring sensors	903289
II.2.5.13.	Flight stabilization system electrooptical drives, including fiber-optic measuring instruments, fiber-optic communications lines, converters, servo elements (control surfaces, rotating nozzle, and so forth)	903289
II.2.5.14.	Flight stabilization system electromechanical drives, including amplifier (electric), converter, and electromechanical servo motors	903289
II.2.5.15.	Equipment for controlling the position of missiles and RPV's in space, with the equipment set weighing not more than 300 kg, including:	903289
II.2.5.15.1.	gyrostabilizers or autopilots weighing up to 70 kg;	903289

Table 3 (Continued)

Position Number	Name	Classification Code for Foreign Economic Activity
II.2.5.15.2.	servo motors weighing up to 50 kg;	903289
II.2.5.15.3.	analog-digital computers (onboard computer system) weighing up to 60 kg and with a speed of over 250,000 operations per second	847110900
II.2.6.	Electronic equipment	
II.2.6.1.	Radars, including doppler navigation radars with synthetic aperture antennas, emitting pulses 0.1 microsecond in duration, either using pulse compression with a compression factor of 200 or more or having a carrier frequency of 40 GHz or more	852610900
II.2.6.2.	Laser locator systems having a range of at least 10 km	852610900; 901320000
II.2.6.3.	Multibeam radio altimeters with three or more beams, radio altimeters using pulse compression with a compression factor of 200 or more, or having a carrier frequency of 40 GHz or more	852610900
II.2.6.4.	Onboard SHF-band, EHF-band, and optical-band radiometers with the ability to reproduce an image of the earth's surface	852610900
II.2.6.5.	Side-looking radars with a resolution of not more than 10 meters from an altitude of 10 km	852610900
II.2.6.6.	Passive sensors for determining bearing to sources of electromagnetic emissions with an error in determining the bearing of not more than 1 degree	901420900
II.2.6.7.	Passive interferometers with an error in measuring the phase difference of signals from two channels of not more than 30 degrees	852610900
II.2.6.8.	Equipment for compiling reference maps of terrain, consisting of analog-digital image input-output devices and computer with a speed of at least 10 million operations per second	852610900
II.2.6.9.	Onboard equipment for mapping the terrain, including a compiler for compiling terrain maps and an analog or digital correlator with an error in determining the image displacement of a maximum of 1 element	852610900
II.2.6.10.	Receivers of signals of the global navigation system or similar satellites, making it possible to determine the navigational coordinates of a missile or RPV in 200 seconds or less:	
II.2.6.10.1.	able to provide navigation information at speeds of more than 515 m/s (1060 nautical miles per hour) at altitudes of more than 18 km (60,000 feet);	901420190
II.2.6.10.2.	designed or modified for use in the atmosphere on RPV's	901420190; 852691900
II.2.6.11.	Electronic fuses designed to operate at temperatures of more than +125 degrees C with a relative error rate in activation of 1 percent by altitude	360300900
II.2.6.12.	Avalanche transit time diodes or Gunn diodes with a radiating power of at least 3 watts, effective at temperatures of more than +125 degrees C	854110990
II.2.6.13.	Tracking systems using translators installed on the missiles or RPV's, combined with ground or airborne tether support systems, or with space navigation systems, making it possible to measure current coordinates and speed on a real-time basis	903290
II.2.6.14.	Ranging radars combined with optical and infrared observation systems, with an angular resolution better than 3 milliradians, an operating radius of 30 km or more, a linear resolution of better than 10 meters (root-mean-square value), and a speed resolution of better than 3 meters per second	852610
II.2.6.15.	Specially developed millimeter- and decimeter-band radars for measuring radar cross-sections in a range from 0.001 to 10 square meters	852610
II.2.6.16.	Analog and digital computers or digital differential analyzers developed or modified for use on missiles and RPV's and having the ability to function for a long period at temperatures below -45 degrees C and above +55 degrees C or high radiation resistance	847110; 847120
II.2.6.17.	Analog-digital converters used on missiles and RPV's, developed or modified in accordance with the requirements for military equipment, and having:	

Table 3 (Continued)

Position Number	Name	Classification Code for Foreign Economic Activity
II.2.6.17.1.	radiation-resistant, in a watertight construction, integrated circuits for analog-digital conversion with a resolution of 8 bits or more and efficient at temperatures below -54 degrees C and above +125 degrees C;	854211830-854211870; 854219
II.2.6.17.2.	electric elements on printed circuit boards or modules for input analog-digital conversion with a resolution of 8 bits or more, efficient at temperatures below -45 degrees C and above +55 degrees C and including integrated circuits with the characteristics indicated in paragraph II.2.6.17.1.	854280000
II.2.6.18.	Radiation-resistant integrated circuits specially developed for the following conditions (surpassing): neutron level—10^{12} neutrons per sq cm; gamma-radiation—10^{9} rads/sec; total dose of 1500 rads	854211; 854219
II.2.6.19.	Radar-transparent fairings (inserts) capable of withstanding a thermal shock of more than $1 \cdot 10^{3}$ kcal/sq meter at an exposure time of not more than 1 second with an excess pressure pulse of more than 0.5 kg/sq cm	880390990
II.2.7.	Starting and calibrating equipment used in the process of operating missiles and RPV's	
II.2.7.1.	Checkout equipment for prelaunch check-out of missiles and RPV's and their basic components (warhead, front section, stages, engines, control system) with prelaunch checks lasting less than 30 minutes	903180990
II.2.7.2.	Radio transmitters of tactical control systems in the VHF-EHF, HF, MF, and LF bands with a pulse power level of not over 10 kW and a probability of failure-free operation over 0.9	852510900
II.2.7.3.	Sets of initial azimuthal attitude control instruments (radio direction finders, gravimeters, gyrocompasses), including satellite navigation equipment, having an angular error of 1 degree or less	901410900; 901420900
II.2.7.4.	Military vehicles providing mobile basing and launching of missiles and RPV's, equipped with monitoring thermostatic control systems, aiming and multirange communications instruments, and a computer system, and having a 30-day period of independent operation	870590900
II.2.7.5.	Military vehicles providing transportation of missiles and RPV's, their elevation from a horizontal to a vertical position, and their placement on the launcher with a lateral load factor of not more than 1.3 g's	870590900
II.2.7.6.	Combat control and communications military vehicles providing transmission or relay or combat control signals in a wide range of radio frequencies over a distance of 150 km or more	870590900
II.2.7.7.	Shipping and launch containers with an internal volume of over 15 cubic meters Definition: A shipping and launch container is a unit which includes an enclosed shell, most often cylinder-shaped, mechanisms for suspending the missile or RPV inside the container, and in specific cases test equipment, aiming instruments, and also hydraulic, gas, and electric connections.	870590900
II.2.7.8.	Gravimeters, gravimetric gradient indicators (gradientometers), and their special components, developed or modified for air- or sea-based use and having an accuracy equal to 0.7 milligal ($7 \cdot 10^{-6}$ m/s^2 or higher, with a time of reaching a stable measuring mode of not over 2 minutes	903290
II.2.7.9.	Onboard telemetry equipment with at least 300 sensors (temperature, pressure, g-loads, and other parameters) and weighing no more than 150 kg, including cable system	854380900; 852510900; 903040900
II.2.7.10.	Ground telemetry receiver recording equipment with a recording speed of more than 1 million bits per second	852719000
II.2.8.	Test gear and equipment for missiles and RPV's and the basic subsystems	

Table 3 (Continued)

Position Number	Name	Classification Code for Foreign Economic Activity
II.2.8.1.	Vibration tables with digital control and complete feedback or a closed test equipment system; capable of creating vibration overloads of 10 g's (root-mean-square value) at frequencies of 20 Hz to 2000 Hz and with a push force of 5 tonnes or more Note: The term "digital control" pertains to equipment whose functioning (partially or completely) is automatically controlled by specific digital encoded electric signals.	903120
II.2.8.2.	Wind tunnels with a flow velocity of 0.9 M or more	903120000
II.2.8.3.	Test fixtures (stands) having the ability to service solid- or liquid-propellant missiles or their engines with a thrust of over 10 tonnes and measure the thrust vector along three axes	903120000
II.2.8.4.	Climate and anechoic chambers capable of simulating the following flight conditions:	
II.2.8.4.1.	altitude of 15 km or higher;	903120000
II.2.8.4.2.	temperature of -50 to +125 degrees C;	903120000
II.2.8.4.3.	vibration overloads up to 10 g's (root-mean-square value) or more with frequency of 20 to 2000 Hz with a push force of 0.5 tonne or more;	903120000
II.2.8.4.4.	acoustic environment with a sound pressure level of 140 dB or higher (which corresponds to a sound pressure of $2 \cdot 10^{-6}$ kg/sq meter, or with a power output of 4 kW or more for anechoic chambers	903120000
II.2.8.5.	Radiographic equipment capable of generating electromagnetic radiation up to 2 million electron-volts or more, created by bremsstrahlung of accelerated electrons, or up to 1 million electron-volts or more with the use of radioactive sources, other than equipment created specially for medical purposes	854380
II.2.8.6.	Detectors (sensors), including a sensing element on p-type and n-type conduction and a computing device, with a total weight of less than 1 kg, a volume of less than 1 liter, a speed (time interval from irradiation to generation of command) of 15 milliseconds or less, and a limit of more than three exposures	903010900

Table 4

Position Number	Name
II.3.	Technologies
II.3.1.	Technology for production of engines and their components
II.3.1.1.	Design and technology of production of light turbojet and turbofan engines (including variable-cycle engines) of high economy and small dimensions, with the following values of parameters for H = 0 under standard atmospheric conditions: —thrust in takeoff mode from 500 to 2,000 kgf; —unit fuel consumption in cruising mode no more than 0.8 kg/kgf-hr; —unit mass 0.3 kg/kgf of thrust
II.3.1.2.	Design and technology for production of supersonic ramjet engines, pulsejet engines and engines with a combined cycle, including devices for controlling the burning rate, with the following values of parameters for H = 0 under standard atmospheric conditions: t—hrust in takeoff mode from 500 to 2,000 kgf; —unit fuel consumption in cruising mode no more than 0.8 kg/kgf-hr; —unit mass 0.3 kg/kgf of thrust
II.3.1.3.	Design and technology for production of turbine blades using the method of oriented crystallization
II.3.1.4.	Software to maintain assigned thermal regimens and control movement of ingot molds in special vacuum ovens equipped with numerical-control units, and intended for the manufacture of turbine blades using the method of oriented crystallization
II.3.1.5.	Design and technology for the production of solid-fuel missile motor casings
II.3.1.6.	Design and production technology of servo-actuated valves for liquid and gel-like rocket fuel components, designed for a flow rate of 24 liters/minute or more at an absolute pressure of 70 atmospheres or more with an actuator reaction speed not worse than 100 mks, designed to operate in conditions of vibration acceleration exceeding 10 g-loads (root-mean-square value) in the frequency band from 20 to 2000 Hz

Table 4 (Continued)

Position Number	Name
II.3.1.7.	Design and production technology of cryogenic liquid pumps with a shaft rotational speed of 8000 rpm or more or with an outlet pressure of at least 70 atmospheres and designed to operate under vibration acceleration exceeding 10 g-loads (root-mean-square value) in the frequency band from 20 to 2000 Hz
II.3.1.8.	Design and production technology of hybrid rocket engines and their specially designed components
II.3.1.9.	Design and production technology of rolling mills and bending machines with two or more interpolation coordinate axes over which control can be accomplished simultaneously when moving over the contour
II.3.1.10.	Software for numerical control units for rolling mills and bending machines with two or more interpolation coordinate axes over which control can be accomplished simultaneously when moving over the contour
II.3.2.	Production technology of fuels and their components
II.3.2.1.	Production technology for hydrazine, having a concentration of over 70 percent, and its derivatives
II.3.2.2.	Production technology of asymmetric dimethyl hydrazine and monomethyl hydrazine
II.3.2.3.	Technology for the production of liquid oxidizers:
II.3.2.3.1	nitrous anhydride;
II.3.2.3.2.	nitric tetroxide;
II.3.2.3.3	nitric anhydride;
II.3.2.3.4.	inhibited red fuming nitric acid;
II.3.2.3.5.	compounds containing fluorine and one or more atoms of other halogens, oxygen or nitrogen
II.3.2.4.	Design and technology for production of continuous-operation chemical reactors (catalytic high-temperature columns for oxidation, reduction, hydration or increasing distillation concentration) for obtaining hydrazine, non-symmetrical dimethyl hydrazine, pentaborane, nitrous anhydride, nitric tetroxide, nitric anhydride, inhibited red fuming nitric acid and compounds containing liquid fluorine and one or more atoms of other halogens, oxygen or nitrogen
II.3.2.5.	Design and technology of production of fixed storage vessels of cylindrical or spherical shape manufactured entirely of or clad with high-alloy steel with enhanced nickel content and a low level of carbon or aluminum, with a volume of more than 2 cubic meters, provided with valve fittings, bottom plates and special means of neutralizing the vapors of chemically active or toxic components of liquid missile fuels
II.3.2.6.	Design and technology of production of transportable containers of cylindrical shape manufactured entirely of or clad in high-alloy steel with enhanced nickel content and low levels of carbon or aluminum, with a volume of more than 2 cubic meters, thermostat systems and special means of neutralizing the vapors of chemically active or toxic components of liquid missile fuels
II.3.2.7.	Design and technology of production of mobile (on truckbed) systems for gathering, neutralizing and burning off liquid and gaseous chemically active or toxic components of missile fuels at a rate of no less than two cubic meters/minute
II.3.2.8.	Technology of production of ammonium perchlorate with spherical particles no less than 500 μm in diameter
II.3.2.9.	Technology of production of perchlorates, chlorates and chromates in a mixture with metallic powder or other high-energy components of fuel
II.3.2.10.	Technology of production of aluminum powder with purity of 97 percent or more, with spherical particles no less than 500 μm in diameter
II.3.2.11.	Design and technology of production of installations for obtaining spherical powders of aluminum with a fineness of up to 500 μm by spraying a melt in an inert medium (nitrogen)
II.3.2.12.	Technology for production of metallic combustible additives to fuel in the form of particles of no less than 500 μm in size with spherical, spheroidal, flake or granulated shape, containing 97 percent or more of any of the following components:
II.3.2.12.1.	zirconium and its alloys;
II.3.2.12.2.	beryllium and its alloys;
II.3.2.12.3.	magnesium and its alloys;
II.3.2.12.4.	boron and its alloys;
II.3.2.12.5.	zinc and its alloys;
II.3.2.12.6.	mish metal
II.3.2.13.	Design and technology of production of plasmatrons (high-frequency, electric-arc) for obtaining a sprayed or spherical metallic powder with organization of the process in an argon-hydrogen medium
II.3.2.14.	Design and technology of production of electrical-detonation installations for obtaining sprayed or spherical metallic powder with organization of the process in an argon-hydrogen medium
II.3.2.15.	Technology of production of nitramines:
II.3.2.15.1.	octogen;

Table 4 (Continued)

Position Number	Name
II.3.2.15.2.	hexogen
II.3.2.16.	Design and technology of production of bead grinders for fine grist of ammonium perchlorate, octogen and hexogen in an inert medium (freon)
II.3.2.17.	Technology of production of polybutadiene with carboxylic end groups
II.3.2.18.	Technology of production of polybutadiene with hydroxylic end groups
II.3.2.19.	Technology of production of glycidilazide
II.3.2.20.	Technology of production of polybutadiene acrylic acid
II.3.2.21.	Technology of production of polybutadiene nitryl acrylic acid
II.3.2.22.	Technology of production of catalytic and inhibiting additives to solid fuels:
II.3.2.22.1.	triphenyl bismuth;
II.3.2.22.2.	isophoron diisocyanate
II.3.2.23.	Technology of production of modifying components regulating the rate of burn of mixed solid fuels:
II.3.2.23.1	ferrocene;
II.3.2.23.2.	diethylferrocene (DAF) (cathocene);
II.3.2.23.3.	octoxyloferrocene;
II.3.2.23.4.	N-butyl-ferrocene (butacene);
II.3.2.23.5.	lithium fluoride
II.3.2.24.	Technology of production of nitroesters and nitropeptizers:
II.3.2.24.1.	trinitropropantriol (NGTs);
II.3.2.24.2.	trimethylol ethane trinitrate;
II.3.2.24.3.	dinitrate diethylene glycol
II.3.2.24.4.	1,2,4-butane trioltrinitrate;
II.3.2.24.5.	dinitrate triethylene glycol
II.3.2.25.	Technology of production of solid-fuel stabilizers:
II.3.2.25.1.	2-nitrodiphenylamine;
II.3.2.25.2.	N-methyl-*p*-nitroaniline
II.3.2.26.	Technology of production of carborans, decarborans, pentaborans and their derivatives
II.3.2.27.	Technology of production of binding additives to fuels:
II.3.2.27.1.	tris (1-(2-methyl)aziridinyl) phosphorous oxide;
II.3.2.27.2.	trimesol (1-(2-methyl)aziridine);
II.3.2.27.3.	"tepan," by-product of the reaction of tetheline pentamine and acrylonitryl;
II.3.2.27.4.	"tepanol," by-product of the reaction of tetraethylne pentamine, acrylonitryl and glycidol;
II.3.2.27.5.	multifunctional aziridine-amides of isophthalic, trimesic, isocyanuric or trimethyladinine acid in the presence of dimethyl or diethyl aziridine groups
II.3.2.28.	Design and technology of production of dosing and continuous mixers with systems to support mixing in a vacuum in a pressure range from zero to 0.13 atmospheres and the possibility of controlling the temperature in the mixing chamber:
II.3.2.28.1.	dosing mixers with an overall volume of 110 *l* (30 gallons) or more;
II.3.2.28.2.	mobile volume dosing mixers with an overall volume of 1,000 *l* or more;
II.3.2.28.3.	dosing mixers that have at least one non-centrally located mixing drive;
II.3.2.28.4.	continuous mixers with two or more shafts with a productivity of 500 kg/hr or more;
II.3.2.28.5.	continuous mixers with possibility of access to mixing chamber;
II.3.2.28.6.	mixers with a volume of more than 3 cubic meters with planetary mixers for preparation of viscous liquid mixtures;
II.3.2.29.	Design and technology of production of gamma-ray flaw detectors for monitoring the solidity and quality of uniformity of solid-fuel propellants
II.3.2.30.	Technology of production of mixed solid-fuel propellants:
II.3.2.30.1.	firmly attached to the casing of the missile motor;

Table 4 (Continued)

Position Number	Name
II.3.2.30.2.	propellant inserts of mixed solid missile fuels
II.3.2.31.	Technology of production of high-energy fuels such as boron-containing suspensions with unit calorific value of 9,500 kcal (40×10^6 J/kg) or higher
II.3.3.	Technology of production of structural materials employed in the creation of missiles and unmanned aircraft
II.3.3.1.	Technology of production of high-alloy steels with increased nickel content, a low level of carbon and using additional elements for age-hardening that have a limit strength of 150 kg/mm^2 or more at a temperature of +20°C
II.3.3.2.	Technology of production of wolfram and its alloys in the shape of spherical particles or particles obtained by spraying that are identical in dimensions of 500 μm in diameter or less with a purity of 97 percent or more
II.3.3.3.	Technology of production of molybdenum and its alloys in the shape of spherical particles or particles obtained by spraying that are identical in dimensions of 500 μm in diameter or less with a purity of 97 percent or more
II.3.3.4.	Technology of production of composite materials using polymer, carbon, ceramics and metallic matrices, as well as fillers in the form of reinforcing fibers and structures—glass, carbon, boron, silicon carbide, synthetic and metallic—that are intended for use in missile systems and unmanned aircraft, and having a unit tensile strength of more than 7.62×10^4 m and a modulus of elasticity of more than 3.18×10^6 m:
II.3.3.4.1.	manufactured using polyamide, polyimide, polybutylene terephthalic, polycarbonate and phenol-formaldehyde matrices;
II.3.3.4.2.	manufactured using magnesium matrices;
II.3.3.4.3.	manufactured using titanium matrices;
II.3.3.4.4.	using fibers of quartzite threads (frames);
II.3.3.4.5.	using fibers of carbon threads (frames);
II.3.3.4.6.	using a fiber basis of boron fibers (frames);
II.3.3.4.7.	using a fiber basis of aluminum oxide;
II.3.3.4.8.	using a fiber base of silicon carbide;
II.3.3.4.9.	using a fiber basis of wolfram wire;
II.3.3.4.10.	using a fiber base of molybdenum wire;
II.3.3.4.11.	using a fiber basis of titanium wire
II.3.3.5.	Technology of production of composite materials for the manufacture of casings of solid-fuel missile motors, exhaust nozzles and elements of them in the form of items of complex geometric shapes (cylinders, spheres, ovals, ellipses, cones, tori):
II.3.3.5.1.	of carbon composites with a density of 1.4 grams/m^3 or more;
II.3.3.5.2.	of fiberglass composites with a density of 2.5 grams/m^3 or more;
II.3.3.5.3.	of organic composites with a density of 1.3 grams/m^3 or more
II.3.3.6.	Technology of production of internal inserts using mixtures of fire-resistant and insulating materials of polybutadiene with hydroxyl end groups with carbon intended for filling the boundaries between the propellant and the casing of the engine or insulation
II.3.3.7.	Technology of production of insulation for sold-fuel missile motors using resin mixtures
II.3.3.8.	Technology of production of pyrolytic carbon-carbon materials with a three-dimensional reinforcing structure (more than 2 times the directions of the reinforcement) with a density of 1.75 grams/m^3 or more
II.3.3.9.	Technology of production of pyrolytic carbon-carbon materials using the method of winding and facing for thin-walled structural elements with a density of 1.5 grams/m^3 or more
II.3.3.10.	Technology of production of finely dispersed graphite recrystallized in large volume (with a volumetric density of no less than 1.72 grams/m^3 measured at a temperature of +15°C)
II.3.3.11.	Design and technology of production of taping machinery in which the control of the movement and winding of the tape and layers is coordinated and programmed on two or more axes
II.3.3.12.	Software for taping machinery in which the control of the movement and winding of the tape and layers is accomplished on two or more axes
II.3.3.13.	Design and technology of production of machinery for the manufacture of intermediate layers, including adapters and modification devices for weaving, alternating or plaiting fibers with the aim of manufacturing composite structures
II.3.3.14.	Design and technology of production of filament-winding machinery in which the control of the movement, turning and winding of the fibers is programmed and accomplished on three or more axes and which are specially developed for the production of composite structures or layered plastics of fibers and fiber materials
II.3.3.15.	Software for filament-winding machinery in which the control of the movement, turning and winding of the fibers is programmed and accomplished on three or more axes and which are specially developed for the production of composite structures or thin layers of fibers and fiber materials

Table 4 (Continued)

Position Number	Name
II.3.3.16.	Design and technology of production of machine tools for winding (shaping) flat tape from roving with a speed at a level of 15.2 to 30.5 m/min for carbon and aramide fibers and 91.4 to 106.7 m/min for other fibers
II.3.3.17.	Design and technology of production of nozzles specially developed for pyrolytic coatings via the feed of gaseous products dissolving at temperatures of +1300°C to +2900°C and pressures of 1 to 150 mm Hg
II.3.3.18.	Software for controlling the process of compaction and pyrolysis of nozzles of missile motors and warhead tips manufactured of composite materials
II.3.3.19.	Design and technology of production of isostatic presses with an internal diameter of the working cavity of the chamber of 254 mm (10 inches) or more, developing a maximum pressure of 700 atmospheres or more and able to reach and maintain a controlled temperature level of +600°C or more
II.3.3.20.	Design and technology of production of ovens for precipitation of vapors of chemical elements designed or modified for the compaction of composite "carbon-carbon" materials
II.3.3.21.	Technical data (including conditions of production) and description of technological processes to maintain assigned temperatures, pressures and atmospheric composition in autoclaves or hydroclaves in production of composite materials or their partial machining
II.3.3.22.	Technology of production of structural high-temperature and erosion-resistant ceramics using silicon nitride and carbide, functional at a temperature of 2000°K and more
II.3.3.23.	Technology of production of refractory ceramics (such as aluminum oxide) using the method of wet twisting
II.3.3.24.	Technology of production of radio-transparent materials using boron nitride with a dielectric permeability of 2.8 to 6 at frequencies of 100 Hz to 10 GHz and working temperature of 2000°K or more
II.3.3.25.	Technology of production of large structural elements (diameter of 0.5 meters or more) with carbon armored body and silicon-carbide matrix (C-SiC-composites) with density of 1.4—2.1 grams/m^3 and working exposure temperature of +1500°C or more for two hours or more
II.3.3.26.	Design and technology of production of mixers (agitators) for the preliminary mixing of components with a power of 2 to 7.5 kW and volume of 95 to 113 *l*
II.3.3.27.	Design and technology of production of mixers for final mixing of components with power of 14.9 to 37.3 kW and working volume of 75.7 to 378.5 *l*
II.3.3.28.	Design and technology of production of automatic presses and casting machinery providing for a temperature regimen of +200°C or more
II.3.3.29.	Design and technology of production of machinery for obtaining cast shaped composite materials with a productivity of 341 to 1,818 kg/hr
II.3.3.30.	Design and technology of production of casting machinery with force of up to 200 tonnes of force
II.3.3.31.	Design and technology of production of machinery for impregnation of fibers with tensioning of roving from 17.8 to 28.7 N
II.3.3.32.	Design and technology of production of high-temperature ovens for firing of refractory ceramics with working temperatures of +1400°C to +2000°C and residual pressure of 10^{-3} to 10^{-5} atmospheres
II.3.3.33.	Software for program control of fiber modification regimens or firing of refractory ceramics, including dosing in time of quality and quantity of treating reagents, as well as regulation of temperature, pressure and composition of environment within the chamber
II.3.4.	Technology of production of materials to reduce detectability and reflected energy of illumination
II.3.4.1.	Technology of production of high-temperature radio-absorbing materials of gradient and/or interference type, including on the basis of silicone binders and special fillers (metallic powders, soot, ferrites, carbonyl iron), retaining magnetic and dielectric properties at temperatures of +350°C or higher and possessing a wave reflection coefficient of 10 to 30 percent
II.3.4.2.	Technology of production of thermal/erosion-resistant radio-transparent materials and coatings, including using mineral fiberglass of type MSP-K, providing for the resistance of radio-transparent coverings or inserts manufactured from them to the effects of thermal flow up to 1 x 10^3 kcal/m^2-sec with a time of exposure of up to one second, in combination with a surge of excess pressure of more than 0.5 kg/cm^2
II.3.4.3.	Technology of production of glass fabrics and fiberglass contained up to 50 percent (by weight) in the mixture or any of the following heavy elements: neodymium, praseodymium, lanthanum, cerium, dysprosium, ytterbium
II.3.4.4.	Technology of production of coatings, including paints using silicone binding agents specially developed to reduce or tightly limit reflections or emissions in the microwave (from 0.1 to 10 mm), as well as infrared (from 0.7 to 100 μm) and ultraviolet (from 10^{-2} to 0.35 μm) bands of the spectrum
II.3.4.5.	Specially developed software or databases for analysis of reduction of signatures
II.3.5.	Design and technology of production of mechanisms for separating stages of missiles
II.3.5.1.	Design and technology of production of explosive bolts with electric detonators
II.3.5.2.	Design and technology of production of detonating elongated charges (pyrocords)

Table 4 (Continued)

Position Number	Name
II.3.5.3.	Design and technology of production of solid-fuel missile micromotors with thrust of up to 10 kg and unit pulse of no more than 200 kg-sec
II.3.6.	Design and technology of production of apparatus integrated into flight control system, specially designed or modified for missiles or unmanned aircraft, including inertial or other flight control systems using the accelerometers indicated in points II.3.6.5 and II.3.6.6 and the gyroscopes indicated in points II.3.6.7 and II.3.6.8.
II.3.6.1.	Design and technology of production of gyrostabilizers or autopilots providing for directional drift of less than 0.5 degree of angle per hour (one sigma)
II.3.6.2.	Design and technology of production of gyroastrocompasses for determining current location of an aircraft (missile) via the automatic tracking of heavenly bodies, providing for a precision in the delivery of a payload as indicated in point I.1.7.
II.3.6.3.	Design and technology of production of a decimeter-band receiver for on-board satellite navigational gear, with a mass of no more than four kilograms
II.3.6.4.	Design and technology of production of a digital computer that is part of the on-board satellite-navigation apparatus that performs one million operations per second or more and weighs no more than two kilograms
II.3.6.5.	Design and technology of production of accelerometers of various types, with a sensitivity of 0.05 Gs or less and a linear error of 0.25 percent of the full scale
II.3.6.6.	Design and technology of production of accelerometers of any type for measuring linear G-forces that are able to function at accelerations of more than 100 Gs.
II.3.6.7.	Design and technology of production of gyroscopes of any type able to function at accelerations of more than 100 Gs
II.3.6.8.	Design and technology of production of all types of gyroscopes used in control systems with a precision (drift) of less than 0.5 degree of angle per hour (one sigma) at normal force of gravity
II.3.6.9.	Design and technology of production of equipment for controlling position of missiles and unmanned aircraft in space with a mass of the full set of not more than 300 kg, including:
II.3.6.9.1.	gyrostabilizers or autopilots with a mass up to 70 kg;
II.3.6.9.2.	control-surface actuators with a mass up to 50 kg;
II.3.6.9.3.	analog-digital computer devices (on-board computers) with a mass up to 60 kg and performing more than 250,000 operations per second
II.3.6.10.	Design and technology of production of body of an aircraft, engine, bearing and control surfaces used to optimize aerodynamic characteristics of unmanned aircraft in all flight modes
II.3.6.11.	Method of integrating (processing) data for control, guidance and movement into a unified measuring system for flight stabilization, in order to optimize the movement of the missile and unmanned aircraft along a trajectory
II.3.7.	Design and technology of production of radio-electronic equipment
II.3.7.1.	Design and technology of production of radar sets, including Doppler navigational radar with antennas using a synthesized aperture, emitting pulses of a duration of 0.1 μm, or using pulse compression with a compression factor of 200 or more, or having a carrier frequency of 40 GHz or more
II.3.7.2.	Design and technology of production of laser location systems with an operating range of not less than 10 km
II.3.7.3.	Design and technology of production of multiple-beam radio altimeters with three or more beams, as well as radio altimeters using pulse compression with a compression factor of 200 or more, or having a carrier frequency of 40 GHz or more
II.3.7.4.	Design and technology of production of on-board radiometers in the centimeter and millimeter radio wavebands and the optical band, with the capability of reproducing an image of the Earth's surface
II.3.7.5.	Design and technology of production of lateral-scan radars with a resolution capacity on a plane of no more than 100 meters from an altitude of 10 km
II.3.7.6.	Design and technology of production of passive sensors to determine the bearing to sources of electromagnetic emissions with an error in determination of the bearing of no more than one degree
II.3.7.7.	Design and technology of production of passive interferometers with an error in signal phase difference measurement of no more than 30°
II.3.7.8.	Design and technology of production of equipment for composing standard terrain maps, consisting of analog-digital devices for the input and output of images and a computer with a speed of operation of no less than 10 million operations per second
II.3.7.8.1.	Software for analog-digital devices for the input and output of images and computers intended for the composition of standard terrain maps
II.3.7.9.	Design and technology of production of on-board equipment for mapping terrain, including a translator for the composition of terrain maps and an analog or digital collector with an error in determining image displacement of a maximum of one element

Table 4 (Continued)

Position Number	Name
II.3.7.10.	Design and technology of production of receivers of signals from a global navigational system, or satellite for analogous purpose, that makes it possible to determine the navigational coordinates of a missile or unmanned aircraft in 200 seconds or less:
II.3.7.10.1.	able to provide navigational information at speeds of more than 515 meters/second (1,060 nautical miles per hour) at altitudes of more than 18 km (60,000 feet);
II.3.7.10.2.	designed or modified for use in the atmosphere on unmanned aircraft
II.3.7.11.	Design and technology of production of radio detonators intended for operation at temperatures of more than 125°C with a relative error of actuation of one percent by altitude
II.3.7.12.	Design and technology of production of avalanche transit-time diodes or Gunn-effect diodes with an emitting power of no less than three watts and functional at temperatures of more than 125°C
II.3.7.13.	Design and technology of production of radar sets for determining range, combined with optical and infrared surveillance systems with an angular resolution of better than three milliradians, an operating radius of 30 km or more, with a linear resolution of better than 10 meters (mean squared value) and resolution in speed of better than three meters/second
II.3.7.14.	Design and technology of production of specially developed radar sets in the millimeter and decimeter wavebands for measuring radar signatures in a range of 0.001 to 10 m^2
II.3.7.15.	Design and technology of production of on-board analog and digital computers or digital differential analyzers, developed or modified for application on missiles or unmanned aircraft with the ability for prolonged functioning at temperatures below -45°C and above +55°C or with high radiation resistance
II.3.7.16.	Design and technology of production of analog-digital converters used on missiles and unmanned aircraft and developed or modified in accordance with the requirements of military engineering:
II.3.7.16.1.	design and technology of production of radiation-resistant microcircuitry of airtight design for analog-digital converters, with a resolution of eight bits or more and functional at temperatures below -54°C and above +125°C;
II.3.7.16.2.	design and technology of production of electrical elements on printed-circuit boards or modules for input analog-digital conversion, with a resolution of eight bits or more and functional at temperatures below -45°C and above +55°C and including integrated circuits with the characteristics indicated in point II.3.7.16.1
II.3.7.17.	Design and technology of production of radiation-resistant integrated circuits specially developed for conditions of external influences exceeding: —level of neutrons = 10^{12} neutrons/cm^2; —gamma radiation = 10^9 rads/sec; —total dose = 1,500 rads
II.3.7.18.	Technology of manufacture and application of polymer composites using silicone binding agents and filled with microspheres of lanthanum, neodymium and tin
II.3.7.19.	Technology of production of carbon fabric of TGN-2M type, with a density of 0.55 grams/cm^2 and a heat capacity of 0.67 kJ/kg-K
II.3.7.20.	Methods of selecting an efficient configuration of electrical circuits and subsystems protected against electromagnetic pulses and electromagnetic interference from external sources
II.3.7.21.	Methods of selecting criteria for the protection of on-board radio-electronic equipment and electrical subsystems against electromagnetic pulses and electromagnetic interference from external sources
II.3.8.	Design and technology of production of launch check-out equipment and equipment used in the process of operating missiles and unmanned aircraft
II.3.8.1.	Design and technology of production of radio transmitters for combat command-and-control systems in the infrared, short-wave, medium-wave and long-wave bands, with a pulse power level of not more than 10 kW and a likelihood of failure-free operation of more than 0.9
II.3.8.2.	Design and technology of production of transport and launch canisters with an internal volume of more than 15 m^3
II.3.8.3.	Design and technology of production of gravimeters, gravimetric gradient meters (gradiometers) and their special components, developed or modified for aerial or naval use and with a static or operational precision equal to 0.7 milligals (7 x 10^{-6} m/sec^2) or more, with a time to reach stable mode of no more than two minutes
II.3.8.4.	Design and technology of production of ground receiving apparatus for telemetric measurements at a recording rate of more than one million bits per second
II.3.9.	Design and technology of production of testing devices and equipment for missiles and unmanned aircraft
II.3.9.1.	Design and technology of production of vibration-test jigs with digital control and full feedback, or a self-contained system of testing equipment able to create vibration loads of 10 Gs (mean squared value) or more at frequencies of 20 Hz to 2,000 Hz with a pushing force of five tonnes or more
II.3.9.2.	Design and technology of production of wind tunnels with flow speeds of Mach 0.9 or more

Table 4 (Continued)

Position Number	Name
II.3.9.3.	Design and technology of production of test beds (jigs) with the ability to support solid- or liquid-fueled missiles or their engines with a thrust or more than 10 tonnes and measurement of the thrust vector on three axes
II.3.9.4.	Design and technology of production of climatic and anechoic chambers able to simulate external flight conditions of:
II.3.9.4.1.	an altitude of 15 km or more;
II.3.9.4.2.	a temperature of -50°C to +125°C;
II.3.9.4.3.	vibration loads up to 10 Gs (mean squared value) or more at a frequency of 20 Hz to 2,000 Hz with a pushing force of 0.5 tonnes or more;
II.3.9.4.4.	an acoustic environment with sonic pressure of 140 dB or more (which corresponds to a sonic pressure of 2×10^{-6} kg/m^2) or reaching a power of four kW or more for anechoic chambers
II.3.9.5.	Design and technology of production of radiographic equipment able to generate electromagnetic emissions of up to two MeV or more, creating a bremsstrahlung of accelerated electrons, or one MeV or more using radioactive sources, aside from equipment that is specially created for medical purposes
II.3.9.6.	Design and technology of production of detectors (sensors), including sensing elements for *p-n* conductivity and a computer device with a total weight of less than one kilogram, volume of less than one *l*, speed of operation (time interval from illumination to issue of command) of 15 μs or less and an allowable quantity of influences of more than three
II.3.9.7.	Specially developed software for a computer, including hybrid (analog-digital) computers, intended for modeling, simulation and automated design engineering of missiles and unmanned aircraft, their separate stages, engine installations and other systems as represented in category I of this list
	Note:
	Modeling includes in particular the aerodynamic and thermodynamic analysis of systems
II.3.9.8.	Software providing the opportunity of post-flight analysis of data entries and determination of the position of the craft through the characteristics of its movement

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